adhesive used causes difficulties in laser drilling of micro-vias. Also it wastes metal.

Another means of attempting to improve adhesion has been by coating a liquid polyimide (or its precursor polyamic acid) onto a roughened metal foil (eg copper foil), followed by curing. However, fine line circuitry is once again difficult to achieve owing to the thickness of the metal foil.

Another known method for attempting to improve adhesion is the sputtering of a thin layer of chromium onto a polymer surface. A thin layer of copper is then sputtered onto the chromium layer. This copper layer is then thickened using electroplating. Although this method is able to produce fine line circuitry (by the use of a photoresist before the electroplating step) the sputtering steps are expensive and time consuming.

Also, in all of the above methods, the drilling of micro-vias through the metal coated polymer film is difficult. Also, after drilling, the micro-vias need to be plated separately.

Another technique to make metal-clad polymer films is electroless plating. However, the polymer surface needs to be activated (seeded) with a catalyst to initiate electroless plating. For instance, it has been found that palladium (Pd) is the most effective catalyst to initiate electroless plating.

The present invention is directed towards an improved method for activating a polymer substrate for electroless plating so as to achieve good adhesion between the substrate and a subsequently applied metal coating.

Summary of the invention

According to a first embodiment of this invention, there is provided a method of activating and metallising an aromatic polymer film including the steps of:

- treating a first surface of the film with a basic solution;
- applying to said first surface an aqueous seeding solution comprising polymer-stabilised catalyst particles; and

- immersing the film in an electroless plating bath comprising ions of a desired metal so as to deposit a layer of said metal onto the first surface of said film.

Preferably the basic solution is a solution of sodium hydroxide (NaOH) or, more preferably, potassium hydroxide (KOH). A relatively wide range of concentrations is suitable for this solution (eg. 0.2 to 2M). The basic solution may be applied by immersing the film in a bath of the basic solution. Alternatively, the basic solution may be applied by spraying a layer of the solution onto the first surface of the film. The surface (or surfaces) of the film which is (or are) to be activated should be maintained in contact with the basic solution for a certain period of time, depending upon the molarity and temperature of the basic solution (for example from 1 to 15 minutes for a 1M KOH solution at room temperature). After immersion (or spraying), the basic solution is washed off, preferably with de-ionised water. Application of the basic solution is typically conducted at temperatures of between 20° to 60° Celsius.

In some cases, after treating the polymer film with the basic solution (eg. KOH), the polymer film is subsequently treated with an acidic solution for protonation of the carboxylate ions formed on the surface. It is done by immersing the KOH treated film in an aqueous acid solution for a certain period of time (e.g. 2 to 20 minutes). Later on it is washed with de-ionised water and is dried, usually with flowing air.

It is preferred that the aqueous seeding solution contains polymer-stabilised palladium particles. This stabilisation may be effected by a water-soluble polymer, such as polyvinyl pyrrolidone (PVP) or polyvinyl alcohol (PVA), although PVP is particularly preferred.

Typically the abovementioned palladium particles will have diameters of from 1 to 50 nm, or more preferably, from 2 to 10 nm.

The aqueous seeding solution is typically applied to the film by immersing the film in a bath of the seeding solution. This immersing typically occurs for between 2 and 60 seconds. After this, the film is removed from the bath and

Claims

The claims defining this invention are as follows:

1. A method of activating and metallising an aromatic polymer film including the steps of:
   - treating a first surface of the film with a basic solution ;
   - applying to said first surface of the film an aqueous seeding solution comprising polymer-stabilised catalyst particles; and
   - immersing the film in an electroless plating bath comprising ions of a desired metal so as to deposit a layer of said metal onto the first surface of said film.
2. The method of claim 1, wherein the basic solution is a solution of potassium hydroxide.
3. The method of claim 1 or claim 2, wherein after the basic solution treatment step, an acidic solution is applied to said first surface.
4. The method of claim 3 wherein the acidic solution is a solution of protic acid such as hydrochloric acid (HCl) or acetic acid.
5. The method of any one of claims 1 to 4, wherein the aqueous seeding solution comprises polymer-stabilised palladium particles.
6. The method of any one of claims 1 to 5, wherein the catalyst particles are stabilised by a water-soluble polymer.
7. The method of claim 6, wherein the water-soluble polymer is polyvinyl pyrrolidone (PVP) or polyvinyl alcohol (PVA).
8. The method of claim 7, wherein the water-soluble polymer is PVP.
9. The method of any one of claims 5 to 8, wherein the palladium particles have diameters of from 1 to 50 nanometers.
10. The method of any one claims 1 to 9, wherein the desired metal is selected from the group consisting of nickel, copper and gold.